

# BLENDING LEARNING IN THE DESIGN OF COLLECTIVE PROTECTIONS IN BUILDING WORKS

**M<sup>a</sup> Nieves González García<sup>1</sup>, Esther Moreno Fernández<sup>1</sup>, Alfonso Cobo Escamilla<sup>2</sup>**

<sup>1</sup> *Dpt. Construcciones Arquitectónicas y su Control, Escuela Universitaria de Arquitectura Técnica e Ingeniería de Edificación. Universidad Politécnica de Madrid (SPAIN)*

<sup>2</sup> *Dpt. Tecnología de Edificación. Escuela Universitaria de Arquitectura Técnica e Ingeniería de Edificación. Universidad Politécnica de Madrid (SPAIN)*

*Mariadelasnieves.gonzalez@upm.es Esther.moreno@upm.es alfonso.cobo@upm.es*

## Abstract

The design of collective protections of construction works is a topic that is integrated within one of the MBTI subjects. This paper presents an experience for teaching the design of collective protection in building works. Teaching has been done in a blended way.

This subject is taught as part of the content of a wider subject included in the Master "Building Technological Innovation" (MBTI) of the Universidad Politécnica de Madrid (UPM). This Master's degree is a postgraduate of research nature.

Graduating in MBTI implies that students are in a position to begin their PhD thesis. At this stage, often students are not able to follow the rigour established by the schedule of classes. For this reason it is interesting that part of the teaching is developed in a non-classroom based way.

## 1 INTRODUCTION

The traditional delivery system for higher education has been a classroom setting with a professor giving a lecture and students listening and writing notes. Interaction between the professor and student has been viewed as an essential learning element within this arrangement. However, innovations in educational delivery mechanisms have challenged this paradigm. Advances in information technology (IT) are enabling little used educational delivery methods such as distance learning (DL) to gain new life. In addition, the advances in IT have ushered in a new paradigm, on-line learning (OL).

Virtual education, eLearning, teaching online are synonymous with a new form of Education. That is being introduced progressively in the teaching practice. Years ago that the Information and Communication Technologies (ICT) derived from Internet demonstrated their Possibilities in the reduction of the costs of education. However, it still remains the controversy surrounding their pedagogical possibilities in the improvement of learning [2].

Currently, at Technical Architecture School, two different postdegree studies are taught: master's degree in construction management and master's degree in Building Technological Innovation.

The Master's degree in Building Technological Innovation (MBTI) of the UPM is a postgraduate of research nature.

Graduating in MBTI implies that students are in a position to begin their PhD thesis. At this stage, often students are not able to follow the rigour established by the schedule of classes. For this reason it is interesting that part of the teaching is developed in a non-classroom based way.

The design of collective protections of construction works is a topic that is integrated within one of the MBTI subjects. This paper analyzes a teaching experience of this subject based on a blended methodology.

There are some fundamental aspects that are highlighted in the literature as the main advantages of online education; Convenience and flexibility, Student enrichment and Cost-effectiveness are some of that variables that have contributed to online learning's growth.

Convenience and flexibility:

1. **Schedule Flexibility:** Students can access at any time, from anywhere they can log on, in most cases. This means that students have the option of attending classes no matter their work schedule. Students only need a computer and Internet access to take online classes.
2. **Ease of accessibility:** Courseware can be accessible for students when they need it. Students can review lectures, discussions, explanations, and comments. Individuals can also share notes with each other to help facilitate community learning.
3. **Students control study time:** On-campus courses are typically scheduled in a more rigid format, with shorter classes running 50 minutes, and others running longer. One of the benefits of online education is that students may not have to sit for long periods of time. Lessons can be paused when needed, and notes read at will.

Student enrichment:

1. **Chance for interaction:** Online courses could help to increase student interaction. By allowing everyone to have a voice, shared ideas grow diverse as well. Students can also think longer about what they want to say and add their comments when ready. In a traditional classroom, the conversation could have moved past the point where the student may be willing to comment.
2. **Online communications:** Teachers can be more approachable in the online setting. Students may feel more comfortable talking openly with their teachers through online chats, emails, and newsgroup discussions rather than face-to-face.
3. **Time to absorb material:** Positive results are reported for students enrolled in online classes, according to a study by the U.S. Department of Education (DOE, 2010): "on average, students in online learning conditions performed modestly better than those receiving face-to-face instruction. The report noted benefits in studies in which online learners spent more time on task than students in the face-to-face condition.

Cost-effective choices:

1. **No more expensive textbooks:** Web-based classes may not require physical textbooks.

An investigation was carried out in the United States about Evaluation of Evidence-Based Practices in Online Learning. A Meta-Analysis and Review of Online Learning Studies. The results show that, on average, students in online learning conditions performed modestly better than those receiving face-to-face instruction. The difference between student outcomes for online and face-to-face classes—measured as the difference between treatment and control means, divided by the pooled standard deviation—was larger in those studies contrasting conditions that blended elements of online and face-to-face instruction with conditions taught entirely face-to-face. Analysts noted that these blended conditions often included additional learning time and instructional elements not received by students in control conditions. This finding suggests the positive effects associated with blended learning.

With this background it was decided to apply blended learning to this course in order to take in account the advantages of both online and face to face education.

## 2 METHODOLOGY

Teaching this topic is very difficult. Rigorous analysis of collective protections of construction works is a multidisciplinary subject in which materials, construction, prevention and structural analysis knowledge is required.

Case of structural analysis, elements measurement requires, in many instances, a non-linear analysis both in materials and geometry and, in addition, of elements subjected to an impact load. This makes that, in practice, the knowledge cannot reach a large number of students and therefore it has been decided of an analysis of experimental type instead of numerical.

The workload of the subject is 2.5 ECTS which distribution is showed in table 1.

Table 1 Distribution of the workload of subject.

Module	ECTS	Teaching
Introduction. Typology. Normative	0.5	On-site

Design of collective protections	1.5	Online
Conclusions. Work exposition	0.5	On-site

The first module introduces the subject and sets out the different types of collective protections and the rules standard that regulate them are displayed. This module is on-site based and it last 5 hours (0.5 ECTS).

Collective protections design is the main part of the subject and is online with a workload of 1.5 ECTS. In this module the learning material consist of slides with an explanation, a document and videos showing tests conducted on collective protections.

The student can access to a platform for online teaching and he can download the information.

For each of the topics the student receives the following information:

- A set of 20 slides with a text that explains them.
- A document where the theme contents are developed.
- Videos where different laboratory tests are displayed in detail. The idea is that the video replaces the visit to the laboratory where in situ testing is performed. The videos show static and impact tests on collective protections. Handrails made of wood, steel and aluminium alloys are tested. The student will verify the different behaviours of the protections according to the used material.

In the last module conclusions are exposed and the students present a work in which they have developed collective protection design, based on the content and on the development of the two previous modules. The workload of this module is 0,5 ECTS. Teaching is classroom based.

### 3 CONCLUSIONS

The blended teaching of a multidisciplinary and complex subject as is the design of collective protections of building works, has been a success.

If the results obtained by this experience are compared with those from other courses in which teaching was provided in a traditional way, it can be proved that students have gotten more involved in the learning process, have acquired more skills and have obtained better results.

The use of ICTs in teaching allows students to have access to information and activities in a continuous manner, which increases their interest and their performance. It also manages to arouse student interest in the subject, improve their creative, communicative and collaborative skills. The use of ICTs allows access to as much information and gets more learning in less time.

All enrolled students have been able to follow the development of the teaching. The works done by the students have shown a great quality in its technical aspects.

The good results obtained with this experience have encouraged as to extend this way of teaching to other subjects of the MBTI.

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